AD NO. ______________________________
DTC PROJECT NO. 8-CO-160-UXO-021
REPORT NO. ATC-8953

STANDARDIZED

UXO TECHNOLOGY DEMONSTRATION SITE

BLIND GRID SCORING RECORD NO. 690

SITE LOCATION:
U.S. ARMY YUMA PROVING GROUND

DEMONSTRATOR:
PARSONS
1700 BROADWAY, No. 900
DENVER, CO 80290

TECHNOLOGY TYPE/PLATFORM:
EM61-MKII/PUSHCART

PREPARED BY:
U.S. ARMY ABERDEEN TEST CENTER
ABERDEEN PROVING GROUND, MD 21005-5059

APRIL 2005

Prepared for:
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14. ABSTRACT
This scoring record documents the efforts of Parsons to detect and discriminate inert unexploded ordnance (UXO) utilizing the YPG Standardized UXO Technology Demonstration Site Blind Grid. The scoring record was coordinated by Larry Overbay and by the Standardized UXO Technology Demonstration Scoring Committee. Organizations on the committee include the U.S. Army Corps of Engineers, the Environmental Security Technology Certification Program, the Strategic Environmental Research and Development Program, the Institute for Defense Analysis, the U.S. Army Environmental Center, and the U.S. Army Aberdeen Test Center.

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SECTION 1. GENERAL INFORMATION

1.1 BACKGROUND

Technologies under development for the detection and discrimination of unexploded ordnance (UXO) require testing so that their performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland and U.S. Army Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multi-agency program spearheaded by the U.S. Army Environmental Center (AEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

1.2 SCORING OBJECTIVES

The objective in the Standardized UXO Technology Demonstration Site Program is to evaluate the detection and discrimination capabilities of a given technology under various field and soil conditions. Inert munitions and clutter items are positioned in various orientations and depths in the ground.

The evaluation objectives are as follows:

a. To determine detection and discrimination effectiveness under realistic scenarios that vary targets, geology, clutter, topography, and vegetation.

b. To determine cost, time, and manpower requirements to operate the technology.

c. To determine demonstrator's ability to analyze survey data in a timely manner and provide prioritized "Target Lists" with associated confidence levels.

d. To provide independent site management to enable the collection of high quality, ground-truth, geo-referenced data for post-demonstration analysis.

1.2.1 Scoring Methodology

a. The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver-operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of false positive (P_{fp}), and those that do not correspond to any known item, termed background alarms.

b. The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the blind grid RESPONSE STAGE, the demonstrator provides the scoring committee with a target response from each and every grid square along with a noise level below which target responses are deemed insufficient to warrant further investigation. This list is generated with minimal processing and, since a value is provided for every grid square, will include signals both above and below the system noise level.

c. The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such and to reject clutter. For the blind grid DISCRIMINATION STAGE, the demonstrator provides the scoring committee with the output of the algorithms applied in the discrimination-stage processing for each grid square. The values in this list are prioritized based on the demonstrator's determination that a grid square is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For digital signal processing, priority ranking is based on algorithm output. For other discrimination approaches, priority ranking is based on human (subjective) judgment. The demonstrator also specifies the threshold in the prioritized ranking that provides optimum performance, (i.e. that is expected to retain all detected ordnance and rejects the maximum amount of clutter).

d. The demonstrator is also scored on EFFICIENCY and REJECTION RATIO, which measures the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from non-ordnance items. EFFICIENCY measures the fraction of detected ordnance retained after discrimination, while the REJECTION RATIO measures the fraction of false alarms rejected. Both measures are defined relative to performance at the demonstrator-supplied level below which all responses are considered noise, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

e. All scoring factors are generated utilizing the Standardized UXO Probability and Plot Program, version 3.1.1.

1.2.2 Scoring Factors

Factors to be measured and evaluated as part of this demonstration include:

a. Response Stage ROC curves:

(1) Probability of Detection (P_d^{res}).

(2) Probability of False Positive (P_{fp}^{res}).

(3) Background Alarm Rate (BAR^{res}) or Probability of Background Alarm (P_{BA}^{res}).

b. Discrimination Stage ROC curves:

(1) Probability of Detection (P_d^{disc}).

(2) Probability of False Positive (P_{fp}^{disc}).

(3) Background Alarm Rate (BAR^{disc}) or Probability of Background Alarm (P_{BA}^{disc}).

c. Metrics:

(1) Efficiency (E).

(2) False Positive Rejection Rate (R_{fp}).

(3) Background Alarm Rejection Rate (R_{BA}).

d. Other:

(1) Probability of Detection by Size and Depth.

(2) Classification by type (i.e., 20-mm, 40-mm, 105-mm, etc.).

(3) Location accuracy.

(4) Equipment setup, calibration time and corresponding man-hour requirements.

(5) Survey time and corresponding man-hour requirements.

(6) Reacquisition/resurvey time and man-hour requirements (if any).

(7) Downtime due to system malfunctions and maintenance requirements.

1.3 STANDARD AND NONSTANDARD INERT ORDNANCE TARGETS

The standard and nonstandard ordnance items emplaced in the test areas are listed in Table 1. Standardized targets are members of a set of specific ordnance items that have identical properties to all other items in the set (caliber, configuration, size, weight, aspect ratio, material, filler, magnetic remanence, and nomenclature). Nonstandard targets are ordnance items having properties that differ from those in the set of standardized targets.

TABLE 1. INERT ORDNANCE TARGETS

Standard Type	Nonstandard (NS)
20-mm Projectile M55	20-mm Projectile M55
	20-mm Projectile M97
40-mm Grenades M385	40-mm Grenades M385
40-mm Projectile MKII Bodies	40-mm Projectile M813
BDU-28 Submunition	
BLU-26 Submunition	
M42 Submunition	
57-mm Projectile APC M86	
60-mm Mortar M49A3	60-mm Mortar (JPG)
	60-mm Mortar M49
2.75-inch Rocket M230	2.75-inch Rocket M230
	2.75-inch Rocket XM229
MK 118 ROCKEYE	
81-mm Mortar M374	81-mm Mortar (JPG)
	81-mm Mortar M374
105-mm HEAT Rounds M456	
105-mm Projectile M60	105-mm Projectile M60
155-mm Projectile M483A1	155-mm Projectile M483A
	500-lb Bomb
	M75 Submunition

HEAT = high-explosive, antitank
JPG = Jefferson Proving Ground.

SECTION 2. DEMONSTRATION

2.1 DEMONSTRATOR INFORMATION

2.1.1 Demonstrator Point of Contact (POC) and Address

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2.1.2 System Description (provided by demonstrator)

Parsons will locate and flag detectable anomalies at the Standardized Test Sites (except the Active Response Area) using electromagnetic (EM) detection systems. Locations of detected anomalies will be surveyed and results reported on "dig sheets".

Parsons will mobilize two, two-man EM crews to APG with a geophysicist, and safely locate detectable anomalies using electromagnetic systems (Geonics EM61-MKII) within the Standardized UXO Technology Demonstration Site at APG, including the blind grid (0.48 acres), open field (13.68 acres), moguls (1.3 acres), and wooded (1.35 acres) areas, but not including the Active Response Area (3.5 acres). As each anomaly is detected, its location will be marked by a pin flag.

A two-man survey crew will next survey the flagged locations of detected anomalies using a Real-Time Kinematic (RTK) Global Positioning System (GPS) instrument. Locations will be recorded in Universal Transverse Mercator (UTM) coordinates on the Standardized UXO Technology Demonstration Site Program Reporting Spreadsheets (Dig Sheets). The survey crew will use a Trimble 5700 RTK-GPS survey instrument in the open field, blind grid, and moguls; and a Trimble Total Station for the wooded areas (where GPS coverage is not available).

Figure 1. Demonstrator's system, EM61-MKII/pushcart.

2.1.3 Data Processing Description (provided by demonstrator)

The process for detection of anomalies using a electromagnetic detection, marking with pin flags, and surveying by RTK GPS is described as follows. At the outset, lanes will be set up to organize work activities. The lanes will be set up on a 100 by 100 meters (m) grid basis and each grid will then be subdivided into lanes that are 1 m wide. The lanes will be marked using ropes stretched between tape measures. Each team will proceed slowly along the lane with the EM61-MKII until the operator detects an anomaly. The anomaly location will then be refined by traversing over the anomaly in at least two different orientations. Once the position of the anomaly has been determined, the second member of the team will place an annotated flag at the location. He will then note the anomaly amplitude in a field book, as well as the lane that the anomaly was found in and the approximate distance along the lane. Once a lane has been completed the team will move to next lane in the grid. Once all the lanes in the grid have been traversed then the team will move on to the next grid.

Once a grid has been completed, then it will become available for surveying. The surveying team will use either a Trimble 5700 or equivalent RTK GPS system for areas where vegetation doesn't prevent the use of GPS, or a Trimble Total Station in areas of dense vegetation. When using the GPS, the instrument will be placed over each flag and location recorded in a digital data logger. The assistant will then remove the flag. In the case of wooded areas, the assistant will place the rod over the flags in the wooded areas and once the operator of the total station indicates that a reading has been acquired, then the assistant will remove the flag and proceed to the next point.

2.1.4 Data Submission Format

Data were submitted for scoring in accordance with data submission protocols outlined in the Standardized UXO Technology Demonstration Site Handbook. These submitted data are not included in this report in order to protect ground truth information.

2.1.5 Demonstrator Quality Assurance (QA) and Quality Control (QC) (provided by demonstrator)

Parsons' Quality Assurance (QA) program consists of an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that the product meets defined standards of quality with a stated level of confidence. Parsons QA/Quality Control (QC) program establishes the methods and procedures that will be used during the project, and is subdivided into two parts as follows:

1. Personnel and Operating Procedure QA/QC; and Instrument/Equipment QA/QC.

- Data Quality Objectives - This project is being conducted to establish the baseline standards of performance for the historical standards of industry for Ordnance and Explosives (OE) detection (electromagnetic detection, and magnetic detection). The data quality objective is to emulate as much as possible the historical methods and data quality achieved historically during normal operation of electromagnetic detection of OE.

- Personnel and Operating Procedure QA/QC - Field QA/QC will be the responsibility of the Senior Geophysicist for the EM detection and survey activities. Field personnel will be geophysicists and operators with experience in the EM and flag (dig) from the U.S. Navy Kaho'olawe Island site where the EM and flag method was used extensively and found to be the most effective method at detecting buried metallic objects, or other location. Personnel will have received training on the equipment that they are operating.

The operators will be familiarized with site conditions by locating anomalies within the calibration lanes on two occasions. The first time will be without any indication of where the buried items are located. This will ensure that they detect all detectable items present. Once they have successfully performed this task, they will repeat the calibration lanes strip with the actual locations of the buried items marked on the surface. This will allow them to refine their positional marking techniques. Once they have completed these two steps, then the teams can proceed to acquisition over the remainder of the site.

2. Instrument/Equipment QA/QC.

- Testing Procedures and Frequency. Instruments and equipment used to locate anomalies and generate survey coordinates will be tested with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

- Function Test. At least twice daily, all geophysical instruments will be function checked by one of two methods. The operational and test procedures will conform to manufacturer's standard instructions. This field test will ensure that the equipment is functioning within the allowable tolerances.

One method is performed by measuring the instrument response over the daily test grid and comparing that response to its standard response recorded prior to being placed in service. For this EE/CA, USA will establish a test grid, containing no less than two seed items, near the site trailer. Use of equipment that deviates by more than 25 percent from the standard response will be discontinued and the equipment will be repaired or replaced. The second method is performed by placing a small metallic test object on the ground in a standard orientation and centered beneath the equipment sensors. The instrument's response is recorded and compared to its initial response measured over the same object prior to being placed in service. For this project, trailer ball hitches will be used as the test objects. If the response in the field is greater than 20 percent of the initial response, the instrument will be repaired or removed from service.

- Preventive Maintenance. Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced prior in accordance with the manufacturer's specified recommendations. Any anomalies in the instrumentation that affect the survey will be noted and the instrument replaced by the vendor. No other maintenance procedures will be used, other than charging the batteries and ensuring that the connectors stay dry.

3. Survey Data Quality Control.

- Data Acquisition. Parsons' Quality Control program ensures the precision and accuracy of analyses by detecting errors and preventing recurrences or measuring the degree of error inherent in the activities and procedures. Any raw data from survey measurements will be appropriately recorded and notated in the field notebooks or Data Loggers.

- Quality control will be conducted for all hardcopy (Dig Sheets) and electronic deliverables. At a minimum the following measures will be conducted:

- Standard coordinate systems (UTM) will be used and verified throughout the project;

- All deliverables will be peer reviewed to ensure accuracy; and electronic data will be backed up periodically.

2.1.6 Additional Records

The following record(s) by this vendor can be accessed via the Internet as MicroSoft Word documents at www.uxotestsites.org.

2.2 YPG SITE INFORMATION

2.2.1 Location

YPG is located adjacent to the Colorado River in the Sonoran Desert. The UXO Standardized Test Site is located south of Pole Line Road and east of the Countermine Testing and Training Range. The Open Field range, Calibration Grid, Blind Grid, Mogul area, and Desert Extreme area comprise the 350 by 500-meter general test site area. The open field site is the largest of the test sites and measures approximately 200 by 350 meters. To the east of the open field range are the calibration and blind test grids that measure 30 by 40 meters and 40 by 40 meters, respectively. South of the Open Field is the 135- by 80-meter Mogul area consisting of a sequence of man-made depressions. The Desert Extreme area is located southeast of the open field site and has dimensions of 50 by 100 meters. The Desert Extreme area, covered with desert-type vegetation, is used to test the performance of different sensor platforms in a more severe desert conditions/environment.

2.2.2 Soil Type

Soil samples were collected at the YPG UXO Standardized Test Site by ERDC to characterize the shallow subsurface (< 3 m). Both surface grab samples and continuous soil borings were acquired. The soils were subjected to several laboratory analyses, including sieve/hydrometer, water content, magnetic susceptibility, dielectric permittivity, X-ray diffraction, and visual description.

There are two soil complexes present within the site, Riverbend-Carrizo and Cristobal-Gunsight. The Riverbend-Carrizo complex is comprised of mixed stream alluvium, whereas the Cristobal-Gunsight complex is derived from fan alluvium. The Cristobal-Gunsight complex covers the majority of the site. Most of the soil samples were classified as either a sandy loam or loamy sand, with most samples containing gravel-size particles. All samples had a measured water content less than 7 percent, except for two that contained 11-percent moisture. The majority of soil samples had water content between 1 to 2 percent. Samples containing more than 3 percent were generally deeper than 1 meter.

An X-ray diffraction analysis on four soil samples indicated a basic mineralogy of quartz, calcite, mica, feldspar, magnetite, and some clay. The presence of magnetite imparted a moderate magnetic susceptibility, with volume susceptibilities generally greater than 100 by 10-5 SI.

For more details concerning the soil properties at the YPG test site, go to www.uxotestsites.org on the web to view the entire soils description report.

2.2.3 Test Areas

A description of the test site areas at YPG is included in Table 2.

TABLE 2. TEST SITE AREAS

Area	Description
Calibration Grid	Contains the 15 standard ordnance items buried in six positions at various angles and depths to allow demonstrator equipment calibration.
Blind Grid	Contains 400 grid cells in a 0.16-hectare (0.39-acre) site. The center of each grid cell contains ordnance, clutter, or nothing.

SECTION 3. FIELD DATA

3.1 DATE OF FIELD ACTIVITIES (29 September and 1 October 2004)

3.2 AREAS TESTED/NUMBER OF HOURS

Areas tested and total number of hours operated at each site are summarized in Table 3.

TABLE 3. AREAS TESTED AND NUMBER OF HOURS

Area	Number of Hours
Calibration Lanes	1.42
Blind Grid	2.58

3.3 TEST CONDITIONS

3.3.1 Weather Conditions

A YPG weather station located approximately one mile west of the test site was used to record average temperature and precipitation on a half hour basis for each day of operation. The temperatures listed in Table 4 represent the average temperature during field operations from 0700 to 1700 hours while precipitation data represents a daily total amount of rainfall. Hourly weather logs used to generate this summary are provided in Appendix B.

TABLE 4. TEMPERATURE/PRECIPITATION DATA SUMMARY

Date, 2004	Average Temperature, °C	Total Daily Precipitation, in.
29 September	26.4	0.00

3.3.2 Field Conditions

During the Parson site survey the field remained dry and the weather conditions were sunny.

3.3.3 Soil Moisture

Three soil probes were placed at various locations within the site to capture soil moisture data: Calibration, Mogul, and Wooded areas. Measurements were collected in percent moisture and were taken twice daily (morning and afternoon) from five different soil depths (1 to 6 in., 6 to 12 in., 12 to 24 in., 24 to 36 in., and 36 to 48 in.) from each probe. Soil moisture logs are included in Appendix C.

3.4 FIELD ACTIVITIES

3.4.1 Setup/Mobilization

These activities included initial mobilization and daily equipment preparation and break down. A two-person crew took 1-hour and 20 minutes to perform the initial setup and mobilization. There was no time spent on daily equipment preparation or end of the day equipment break down.

3.4.2 Calibration

Parsons spent a total of 1-hour and 25 minutes in the calibration lanes, 1-hour and 20 minutes of which was spent collecting data. The other 5 minutes was spent calibrating the system.

3.4.3 Downtime Occasions

Occasions of downtime are grouped into five categories: equipment/data checks or equipment maintenance, equipment failure and repair, weather, Demonstration Site issues, or breaks/lunch. All downtime is included for the purposes of calculating labor costs (section 5) except for downtime due to Demonstration Site issues. Demonstration Site issues, while noted in the Daily Log, are considered non-chargeable downtime for the purposes of calculating labor costs and are not discussed. Breaks and lunches are discussed in this section and billed to the total Site Survey area.

3.4.3.1 Equipment/data checks, maintenance. Equipment data checks and maintenance activities accounted for no site usage time. These activities included changing out batteries and routine data checks to ensure the data was being properly recorded/collected. Parsons spent an additional 1-hour and 30 minutes for breaks and lunches.

3.4.3.2 Equipment failure or repair. No time was needed to resolve equipment failures that occurred while surveying the Blind Grid.

3.4.3.3 Weather. No weather delays occurred during the survey.

3.4.4 Data Collection

Parsons spent a total time of 2 hours and 35 minutes in the Blind Grid area, 1-hour and 5 minutes of which was spent collecting data.

3.4.5 Demobilization

The Parsons survey crew went on to conducted a full demonstration of the site. Therefore, demobilization did not occur until 7 October 2004. On that day, it took the crew 40 minutes to break down and pack up their equipment.

3.5 PROCESSING TIME

Parsons submitted the raw data from the demonstration activities on the last day of the demonstration, as required. The scoring submittal data was also provided within the required 30-day timeframe.

3.6 DEMONSTRATOR'S FIELD PERSONNEL

Ben McCallister
Bart Hoestra

3.7 DEMONSTRATOR'S FIELD SURVEYING METHOD

Parsons collected data in a bi-directional manner, east to west, collecting a total of 175 hits in the Blind Grid area.

3.8 SUMMARY OF DAILY LOGS

Daily logs capture all field activities during this demonstration and are located in Appendix D. Activities pertinent to this specific demonstration are indicated in highlighted text.

SECTION 4. TECHNICAL PERFORMANCE RESULTS

4.1 ROC CURVES USING ALL ORDNANCE CATEGORIES

(NOT APPLICABLE FOR THIS TECHNOLOGY)

4.2 ROC CURVES USING ORDNANCE LARGER THAN 20 MM

(NOT APPLICABLE FOR THIS TECHNOLOGY)

4.3 PERFORMANCE SUMMARIES

Results for the Blind Grid test broken out by size, depth and nonstandard ordnance are presented in Table 5 (for cost results, see section 5). Results by size and depth include both standard and nonstandard ordnance. The results by size show how well the demonstrator did at detecting/discriminating ordnance of a certain caliber range (see app A for size definitions). The results are relative to the number of ordnance items emplaced. Depth is measured from the geometric center of anomalies.

The RESPONSE STAGE results are derived from the list of anomalies above the demonstrator-provided noise level. The results for the DISCRIMINATION STAGE are derived from the demonstrator's recommended threshold for optimizing UXO field cleanup by minimizing false digs and maximizing ordnance recovery. The lower 90 percent confidence limit on probability of detection and P_{fp} was calculated assuming that the number of detections and false positives are binomially distributed random variables. All results in Table 5 have been rounded to protect the ground truth. However, lower confidence limits were calculated using actual results.

TABLE 5. SUMMARY OF BLIND GRID RESULTS FOR THE EM61-MKII/PUSHCART

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
RESPONSE STAGE									
P_d	0.90	0.85	0.90	0.90	0.85	0.95	0.95	0.90	0.30
P_d Low 90% Conf	0.81	0.78	0.78	0.80	0.68	0.75	0.88	0.79	0.08
P_d Upper 90% Conf	0.93	0.93	0.96	0.95	0.92	0.99	0.99	0.98	0.60
P_{fp}	0.95	-	-	-	-	-	0.90	1.00	N/A
P_{fp} Low 90% Conf	0.90	-	-	-	-	-	0.87	0.92	-
P_{fp} Upper 90% Conf	0.97	-	-	-	-	-	0.95	1.00	-
P_{ba}	0.05	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P_d Low 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P_d Upper 90% Conf	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
P_{fp}	N/A	-	-	-	-	-	N/A	N/A	N/A
P_{fp} Low 90% Conf	N/A	-	-	-	-	-	N/A	N/A	-
P_{fp} Upper 90% Conf	N/A	-	-	-	-	-	N/A	N/A	-
P_{ba}	N/A	-	-	-	-	-	-	-	-

Response Stage Noise Level: 0.50.
Recommended Discrimination Stage Threshold: 0.50.

Note: The recommended discrimination stage threshold values are provided by the demonstrator.
No discrimination algorithm was applied. Therefore, the discrimination stage results are not applicable.

4.4 EFFICIENCY, REJECTION RATES, AND TYPE CLASSIFICATION

Due to technical limitations of the system used for this demonstration, no attempt was made to discriminate. Therefore, the following tables presented in this section are not applicable.

Efficiency and rejection rates are calculated to quantify the discrimination ability at specific points of interest on the ROC curve: (1) at the point where no decrease in P_d is suffered (i.e., the efficiency is by definition equal to one) and (2) at the operator selected threshold. These values are reported in Table 6.

TABLE 6. EFFICIENCY AND REJECTION RATES

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	N/A	N/A	N/A
With No Loss of P_d	N/A	N/A	N/A

At the demonstrator's recommended setting, the ordnance items that were detected and correctly discriminated were further scored on whether their correct type could be identified (table 8). Correct type examples include "20-mm projectile, 105-mm HEAT Projectile, and 2.75-inch Rocket". A list of the standard type declaration required for each ordnance item was provided to demonstrators prior to testing. For example, the standard type for the three example items are 20mmP, 105H, and 2.75in, respectively.

TABLE 7. CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS UXO

Size	Percentage Correct
Small	N/A
Medium	N/A
Large	N/A
Overall	N/A

4.5 LOCATION ACCURACY

The mean location error and standard deviations appear in Table 8. These calculations are based on average missed depth for ordnance correctly identified in the discrimination stage. Depths are measured from the closest point of the ordnance to the surface. For the Blind Grid, only depth errors are calculated, since (X, Y) positions are known to be the centers of each grid square.

TABLE 8. MEAN LOCATION ERROR AND STANDARD DEVIATION (M)

	Mean	Standard Deviation
Depth	N/A	N/A

Note: Demonstrator did not attempt to declare depth of detection.

SECTION 5. ON-SITE LABOR COSTS

A standardized estimate for labor costs associated with this effort was calculated as follows: the first person at the test site was designated "supervisor", the second person was designated "data analyst", and the third and following personnel were considered "field support". Standardized hourly labor rates were charged by title: supervisor at $95.00/hour, data analyst at $57.00/hour, and field support at $28.50/hour.

Government representatives monitored on-site activity. All on-site activities were grouped into one of ten categories: initial setup/mobilization, daily setup/stop, calibration, collecting data, downtime due to break/lunch, downtime due to equipment failure, downtime due to equipment/data checks or maintenance, downtime due to weather, downtime due to demonstration site issue, or demobilization. See Appendix D for the daily activity log. See section 3.4 for a summary of field activities.

The standardized cost estimate associated with the labor needed to perform the field activities is presented in Table 9. Note that calibration time includes time spent in the Calibration Lanes as well as field calibrations. "Site survey time" includes daily setup/stop time, collecting data, breaks/lunch, downtime due to equipment/data checks or maintenance, downtime due to failure, and downtime due to weather.

TABLE 9. ON-SITE LABOR COSTS

	No. People	Hourly Wage	Hours	Cost
Initial Setup				
Supervisor	1	$95.00	1.33	$126.35
Data Analyst	1	57.00	1.33	75.81
Field Support	0	28.50	1.33	0.00
SubTotal				**$202.16**
Calibration				
Supervisor	1	$95.00	1.42	$134.90
Data Analyst	1	57.00	1.42	80.94
Field Support	0	28.50	1.42	0.00
SubTotal				**$215.84**
Site Survey				
Supervisor	1	$95.00	2.58	$245.10
Data Analyst	1	57.00	2.58	147.06
Field Support	0	28.50	2.58	0.00
SubTotal				**$392.16**

See notes at end of table.

TABLE 9 (CONT'D)

	No. People	Hourly Wage	Hours	Cost
		Demobilization		
Supervisor	1	$95.00	0.66	$62.70
Data Analyst	1	57.00	0.66	37.62
Field Support	0	28.50	0.66	0.00
Subtotal				**$100.32**
Total				**$910.48**

Notes: Calibration time includes time spent in the Calibration Lanes as well as calibration before each data run.

Site Survey time includes daily setup/stop time, collecting data, breaks/lunch, downtime due to system maintenance, failure, and weather.

SECTION 6.   COMPARISON OF RESULTS TO DATE

No comparisons to date.

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SECTION 7. APPENDIXES

APPENDIX A. TERMS AND DEFINITIONS

GENERAL DEFINITIONS

Anomaly: Location of a system response deemed to warrant further investigation by the demonstrator for consideration as an emplaced ordnance item.

Detection: An anomaly location that is within R_{halo} of an emplaced ordnance item.

Emplaced Ordnance: An ordnance item buried by the government at a specified location in the test site.

Emplaced Clutter: A clutter item (i.e., non-ordnance item) buried by the government at a specified location in the test site.

R_{halo}: A pre-determined radius about the periphery of an emplaced item (clutter or ordnance) within which a location identified by the demonstrator as being of interest is considered to be a response from that item. If multiple declarations lie within R_{halo} of any item (clutter or ordnance), the declaration with the highest signal output within the R_{halo} will be utilized. For the purpose of this program, a circular halo 0.5 meters in radius will be placed around the center of the object for all clutter and ordnance items less than 0.6 meters in length. When ordnance items are longer than 0.6 meters, the halo becomes an ellipse where the minor axis remains 1 meter and the major axis is equal to the length of the ordnance plus 1 meter.

Small Ordnance: Caliber of ordnance less than or equal to 40 mm (includes 20-mm projectile, 40-mm projectile, submunitions BLU-26, BLU-63, and M42).

Medium Ordnance: Caliber of ordnance greater than 40 mm and less than or equal to 81 mm (includes 57-mm projectile, 60-mm mortar, 2.75 in. Rocket, MK118 Rockeye, 81-mm mortar).

Large Ordnance: Caliber of ordnance greater than 81 mm (includes 105-mm HEAT, 105-mm projectile, 155-mm projectile, 500-pound bomb).

Shallow: Items buried less than 0.3 meter below ground surface.

Medium: Items buried greater than or equal to 0.3 meter and less than 1 meter below ground surface.

Deep: Items buried greater than or equal to 1 meter below ground surface.

Response Stage Noise Level: The level that represents the point below which anomalies are not considered detectable. Demonstrators are required to provide the recommended noise level for the Blind Grid test area.

Discrimination Stage Threshold: The demonstrator selected threshold level that they believe provides optimum performance of the system by retaining all detectable ordnance and rejecting the maximum amount of clutter. This level defines the subset of anomalies the demonstrator would recommend digging based on discrimination.

Binomially Distributed Random Variable: A random variable of the type which has only two possible outcomes, say success and failure, is repeated for n independent trials with the probability p of success and the probability 1-p of failure being the same for each trial. The number of successes x observed in the n trials is an estimate of p and is considered to be a binomially distributed random variable.

RESPONSE AND DISCRIMINATION STAGE DATA

The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of false positive (P_{fp}) and those that do not correspond to any known item, termed background alarms.

The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the RESPONSE STAGE, the demonstrator provides the scoring committee with the location and signal strength of all anomalies that the demonstrator has deemed sufficient to warrant further investigation and/or processing as potential emplaced ordnance items. This list is generated with minimal processing (e.g., this list will include all signals above the system noise threshold). As such, it represents the most inclusive list of anomalies.

The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such, and to reject clutter. For the same locations as in the RESPONSE STAGE anomaly list, the DISCRIMINATION STAGE list contains the output of the algorithms applied in the discrimination-stage processing. This list is prioritized based on the demonstrator's determination that an anomaly location is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For electronic signal processing, priority ranking is based on algorithm output. For other systems, priority ranking is based on human judgment. The demonstrator also selects the threshold that the demonstrator believes will provide "optimum" system performance, (i.e., that retains all the detected ordnance and rejects the maximum amount of clutter).

Note: The two lists provided by the demonstrator contain identical numbers of potential target locations. They differ only in the priority ranking of the declarations.

RESPONSE STAGE DEFINITIONS

Response Stage Probability of Detection (P_d^{res}): P_d^{res} = (No. of response-stage detections)/(No. of emplaced ordnance in the test site).

Response Stage False Positive (fp^{res}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Response Stage Probability of False Positive (P_{fp}^{res}): P_{fp}^{res} = (No. of response-stage false positives)/(No. of emplaced clutter items).

Response Stage Background Alarm (ba^{res}): An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Response Stage Probability of Background Alarm (P_{ba}^{res}): Blind Grid only: P_{ba}^{res} = (No. of response-stage background alarms)/(No. of empty grid locations).

Response Stage Background Alarm Rate (BAR^{res}): Open Field only: BAR^{res} = (No. of response-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{res}, P_{fp}^{res}, P_{ba}^{res}, and BAR^{res} are functions of t^{res}, the threshold applied to the response-stage signal strength. These quantities can therefore be written as $P_d^{res}(t^{res})$, $P_{fp}^{res}(t^{res})$, $P_{ba}^{res}(t^{res})$, and $BAR^{res}(t^{res})$.

DISCRIMINATION STAGE DEFINITIONS

Discrimination: The application of a signal processing algorithm or human judgment to response-stage data that discriminates ordnance from clutter. Discrimination should identify anomalies that the demonstrator has high confidence correspond to ordnance, as well as those that the demonstrator has high confidence correspond to non-ordnance or background returns. The former should be ranked with highest priority and the latter with lowest.

Discrimination Stage Probability of Detection (P_d^{disc}): P_d^{disc} = (No. of discrimination-stage detections)/(No. of emplaced ordnance in the test site).

Discrimination Stage False Positive (fp^{disc}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Discrimination Stage Probability of False Positive (P_{fp}^{disc}): P_{fp}^{disc} = (No. of discrimination stage false positives)/(No. of emplaced clutter items).

Discrimination Stage Background Alarm (ba^{disc}): An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Discrimination Stage Probability of Background Alarm (P_{ba}^{disc}): P_{ba}^{disc} = (No. of discrimination-stage background alarms)/(No. of empty grid locations).

Discrimination Stage Background Alarm Rate (BAR^{disc}): BAR^{disc} = (No. of discrimination-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{disc}, P_{fp}^{disc}, P_{ba}^{disc}, and BAR^{disc} are functions of t^{disc}, the threshold applied to the discrimination-stage signal strength. These quantities can therefore be written as $P_d^{disc}(t^{disc})$, $P_{fp}^{disc}(t^{disc})$, $P_{ba}^{disc}(t^{disc})$, and $BAR^{disc}(t^{disc})$.

RECEIVER-OPERATING CHARACERISTIC (ROC) CURVES

ROC curves at both the response and discrimination stages can be constructed based on the above definitions. The ROC curves plot the relationship between P_d versus P_{fp} and P_d versus BAR or P_{ba} as the threshold applied to the signal strength is varied from its minimum (t_{min}) to its maximum (t_{max}) value.[1] Figure A-1 shows how P_d versus P_{fp} and P_d versus BAR are combined into ROC curves. Note that the "res" and "disc" superscripts have been suppressed from all the variables for clarity.

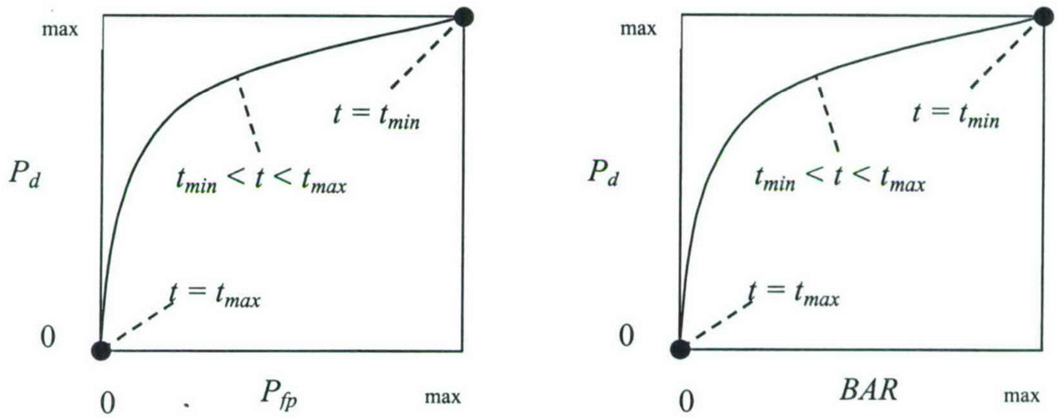

Figure A-1. ROC curves for open field testing. Each curve applies to both the response and discrimination stages.

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[1]Strictly speaking, ROC curves plot the P_d versus P_{ba} over a pre-determined and fixed number of detection opportunities (some of the opportunities are located over ordnance and others are located over clutter or blank spots). In an open field scenario, each system suppresses its signal strength reports until some bare-minimum signal response is received by the system. Consequently, the open field ROC curves do not have information from low signal-output locations, and, furthermore, different contractors report their signals over a different set of locations on the ground. These ROC curves are thus not true to the strict definition of ROC curves as defined in textbooks on detection theory. Note, however, that the ROC curves obtained in the Blind Grid test sites are true ROC curves.

METRICS TO CHARACTERIZE THE DISCRIMINATION STAGE

The demonstrator is also scored on efficiency and rejection ratio, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from non-ordnance items. The efficiency measures the amount of detected ordnance retained by the discrimination, while the rejection ratio measures the fraction of false alarms rejected. Both measures are defined relative to the entire response list, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

Efficiency (E): $E = P_d^{disc}(t^{disc})/P_d^{res}(t_{min}^{res})$; Measures (at a threshold of interest), the degree to which the maximum theoretical detection performance of the sensor system (as determined by the response stage tmin) is preserved after application of discrimination techniques. Efficiency is a number between 0 and 1. An efficiency of 1 implies that all of the ordnance initially detected in the response stage was retained at the specified threshold in the discrimination stage, t^{disc}.

False Positive Rejection Rate (R_{fp}): $R_{fp} = 1 - [P_{fp}^{disc}(t^{disc})/P_{fp}^{res}(t_{min}^{res})]$; Measures (at a threshold of interest), the degree to which the sensor system's false positive performance is improved over the maximum false positive performance (as determined by the response stage tmin). The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all emplaced clutter initially detected in the response stage were correctly rejected at the specified threshold in the discrimination stage.

Background Alarm Rejection Rate (R_{ba}):

Blind Grid: $R_{ba} = 1 - [P_{ba}^{disc}(t^{disc})/P_{ba}^{res}(t_{min}^{res})]$.
Open Field: $R_{ba} = 1 - [BAR^{disc}(t^{disc})/BAR^{res}(t_{min}^{res})])$.

Measures the degree to which the discrimination stage correctly rejects background alarms initially detected in the response stage. The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all background alarms initially detected in the response stage were rejected at the specified threshold in the discrimination stage.

CHI-SQUARE COMPARISON EXPLANATION:

The Chi-square test for differences in probabilities (or 2 x 2 contingency table) is used to analyze two samples drawn from two different populations to see if both populations have the same or different proportions of elements in a certain category. More specifically, two random samples are drawn, one from each population, to test the null hypothesis that the probability of event A (some specified event) is the same for both populations (ref 3).

A 2 x 2 contingency table is used in the Standardized UXO Technology Demonstration Site Program to determine if there is reason to believe that the proportion of ordnance correctly detected/discriminated by demonstrator X's system is significantly degraded by the more challenging terrain feature introduced. The test statistic of the 2 x 2 contingency table is the

Chi-square distribution with one degree of freedom. Since an association between the more challenging terrain feature and relatively degraded performance is sought, a one-sided test is performed. A significance level of 0.05 is chosen which sets a critical decision limit of 2.71 from the Chi-square distribution with one degree of freedom. It is a critical decision limit because if the test statistic calculated from the data exceeds this value, the two proportions tested will be considered significantly different. If the test statistic calculated from the data is less than this value, the two proportions tested will be considered not significantly different.

An exception must be applied when either a 0 or 100 percent success rate occurs in the sample data. The Chi-square test cannot be used in these instances. Instead, Fischer's test is used and the critical decision limit for one-sided tests is the chosen significance level, which in this case is 0.05. With Fischer's test, if the test statistic is less than the critical value, the proportions are considered to be significantly different.

Standardized UXO Technology Demonstration Site examples, where blind grid results are compared to those from the open field and open field results are compared to those from one of the scenarios, follow. It should be noted that a significant result does not prove a cause and effect relationship exists between the two populations of interest; however, it does serve as a tool to indicate that one data set has experienced a degradation in system performance at a large enough level than can be accounted for merely by chance or random variation. Note also that a result that is not significant indicates that there is not enough evidence to declare that anything more than chance or random variation within the same population is at work between the two data sets being compared.

Demonstrator X achieves the following overall results after surveying each of the three progressively more difficult areas using the same system (results indicate the number of ordnance detected divided by the number of ordnance emplaced):

	Blind Grid	Open Field	Moguls
P_d^{res}	100/100 = 1.0	8/10 = .80	20/33 = .61
P_d^{disc}	80/100 = 0.80	6/10 = .60	8/33 = .24

P_d^{res}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the response stage, all 100 ordnance out of 100 emplaced ordnance items were detected in the blind grid while 8 ordnance out of 10 emplaced were detected in the open field. Fischer's test must be used since a 100 percent success rate occurs in the data. Fischer's test uses the four input values to calculate a test statistic of 0.0075 that is compared against the critical value of 0.05. Since the test statistic is less than the critical value, the smaller response stage detection rate (0.80) is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the detection ability of demonstrator X's system seems to have been degraded in the open field relative to results from the blind grid using the same system.

P_d^{disc}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the discrimination stage, 80 out of 100 emplaced ordnance items were correctly discriminated as ordnance in blind grid testing while 6 ordnance out of 10 emplaced were correctly discriminated as such in open field-testing. Those four values are used to calculate a test statistic of 1.12. Since the test statistic is less than the critical value of 2.71, the two discrimination stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{res}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the response stage, 8 out of 10 and 20 out of 33 are used to calculate a test statistic of 0.56. Since the test statistic is less than the critical value of 2.71, the two response stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{disc}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the discrimination stage, 6 out of 10 and 8 out of 33 are used to calculate a test statistic of 2.98. Since the test statistic is greater than the critical value of 2.71, the smaller discrimination stage detection rate is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the ability of demonstrator X to correctly discriminate seems to have been degraded by the mogul terrain relative to results from the flat open field using the same system.

APPENDIX B. DAILY WEATHER LOGS

TABLE B-1. WEATHER LOG

Weather Data from Yuma Proving Ground				
Date	Time, EDST	Average Temperature, °C	RH, %	Precipitation, in.
9/29/2004	0700	17.7	22	0.00
9/29/2004	0800	19.9	21	0.00
9/29/2004	0900	23.9	17	0.00
9/29/2004	1000	25.4	14	0.00
9/29/2004	1100	26.6	13	0.00
9/29/2004	1200	28.2	11	0.00
9/29/2004	1300	28.9	11	0.00
9/29/2004	1400	29.8	9	0.00
9/29/2004	1500	30.2	7	0.00
9/29/2004	1600	30.1	9	0.00
9/29/2004	1700	29.7	9	0.00
9/30/2004	0700	14.6	46	0.00
9/30/2004	0800	18.5	39	0.00
9/30/2004	0900	22.1	31	0.00
9/30/2004	1000	23.4	36	0.00
9/30/2004	1100	25.1	45	0.00
9/30/2004	1200	25.4	39	0.00
9/30/2004	1300	27.6	33	0.00
9/30/2004	1400	28.2	26	0.00
9/30/2004	1500	28.4	28	0.00
9/30/2004	1600	28.8	27	0.00
9/30/2004	1700	28.9	25	0.00
10/1/2004	0700	18.2	69	0.00
10/1/2004	0800	21.3	62	0.00
10/1/2004	0900	23.7	53	0.00
10/1/2004	1000	25.8	46	0.00
10/1/2004	1100	27.2	40	0.00
10/1/2004	1200	-40.1	5	0.00
10/1/2004	1300	27.9	29	0.00
10/1/2004	1400	30.5	25	0.00
10/1/2004	1500	30.9	22	0.00
10/1/2004	1600	31.8	20	0.00
10/1/2004	1700	31.3	20	0.00

TABLE B-1 (CONT'D)

Weather Data from Yuma Proving Ground				
Date	Time, EDST	Average Temperature, °C	RH, %	Precipitation, in.
10/2/2004	0700	17.6	67	0.00
10/2/2004	0800	21.9	55	0.00
10/2/2004	0900	24.6	48	0.00
10/2/2004	1000	26.0	43	0.00
10/2/2004	1100	27.5	35	0.00
10/2/2004	1200	30.3	29	0.00
10/2/2004	1300	31.6	24	0.00
10/2/2004	1400	32.6	20	0.00
10/2/2004	1500	33.4	18	0.00
10/2/2004	1600	32.5	17	0.00
10/2/2004	1700	32.6	18	0.00
10/3/2004	0700	17.4	40	0.00
10/3/2004	0800	21.2	32	0.00
10/3/2004	0900	23.6	28	0.00
10/3/2004	1000	25.7	25	0.00
10/3/2004	1100	28.1	22	0.00
10/3/2004	1200	29.6	19	0.00
10/3/2004	1300	31.3	17	0.00
10/3/2004	1400	32.8	15	0.00
10/3/2004	1500	33.9	14	0.00
10/3/2004	1600	34.7	14	0.00
10/3/2004	1700	34.8	14	0.00
10/4/2004	0700	19.8	34	0.00
10/4/2004	0800	23.1	30	0.00
10/4/2004	0900	27.6	23	0.00
10/4/2004	1000	28.4	22	0.00
10/4/2004	1100	28.3	20	0.00
10/4/2004	1200	31.2	17	0.00
10/4/2004	1300	34.2	13	0.00
10/4/2004	1400	34.5	13	0.00
10/4/2004	1500	35.2	12	0.00
10/4/2004	1600	33.0	11	0.00
10/4/2004	1700	32.5	11	0.00

TABLE B-1 (CONT'D)

Weather Data from Yuma Proving Ground				
Date	Time, EDST	Average Temperature, °C	RH, %	Precipitation, in.
10/5/2004	0700	16.7	50	0.00
10/5/2004	0800	20.6	40	0.00
10/5/2004	0900	23.0	35	0.00
10/5/2004	1000	25.1	31	0.00
10/5/2004	1100	27.3	25	0.00
10/5/2004	1200	28.5	23	0.00
10/5/2004	1300	30.8	18	0.00
10/5/2004	1400	32.4	14	0.00
10/5/2004	1500	33.6	12	0.00
10/5/2004	1600	33.9	10	0.00
10/5/2004	1700	34.7	10	0.00
10/6/2004	0700	19.3	27	0.00
10/6/2004	0800	23.9	23	0.00
10/6/2004	0900	27.2	19	0.00
10/6/2004	1000	29.9	16	0.00
10/6/2004	1100	32.3	14	0.00
10/6/2004	1200	33.6	13	0.00
10/6/2004	1300	32.5	13	0.00
10/6/2004	1400	34.6	12	0.00
10/6/2004	1500	33.9	11	0.00
10/6/2004	1600	34.6	8	0.00
10/6/2004	1700	33.6	8	0.00
10/7/2004	0700	17.1	24	0.00
10/7/2004	0800	20.6	21	0.00
10/7/2004	0900	24.5	16	0.00
10/7/2004	1000	27.9	15	0.00
10/7/2004	1100	30.2	12	0.00
10/7/2004	1200	32.4	9	0.00
10/7/2004	1300	34.2	9	0.00
10/7/2004	1400	34.7	8	0.00
10/7/2004	1500	34.7	8	0.00
10/7/2004	1600	34.8	8	0.00
10/7/2004	1700	34.6	8	0.00

APPENDIX C. SOIL MOISTURE

Date: September 29, 2004
Times: (0700), (1200)

Probe Location:	Layer, in.	AM Reading, %	PM Reading, %
Calibration Area	0 to 6	1.8	1.8
	6 to 12	2.3	2.3
	12 to 24	3.7	3.7
	24 to 36	3.7	3.7
	36 to 48	4.1	4.1
Mogul Area	0 to 6	1.7	1.7
	6 to 12	2.0	2.0
	12 to 24	3.6	3.6
	24 to 36	3.9	3.9
	36 to 48	4.0	4.0
Desert Extreme Area	0 to 6	1.6	1.6
	6 to 12	2.0	2.0
	12 to 24	3.4	3.4
	24 to 36	3.9	3.9
	36 to 48	4.1	4.1

Date: September 30, 2004
Times: (0645), (1200

Probe Location:	Layer, in.	AM Reading, %	PM Reading, %
Calibration Area	0 to 6	1.8	1.8
	6 to 12	2.3	2.3
	12 to 24	3.7	3.7
	24 to 36	3.6	3.7
	36 to 48	4.1	4.1
Mogul Area	0 to 6	1.7	1.7
	6 to 12	2.0	2.0
	12 to 24	3.6	3.6
	24 to 36	3.9	3.9
	36 to 48	4.0	4.0
Desert Extreme Area	0 to 6	1.6	1.6
	6 to 12	2.0	2.0
	12 to 24	3.4	3.4
	24 to 36	3.9	3.9
	36 to 48	4.1	4.1

Date: October 01, 2004
Times: (0630), (1330)

Probe Location:	Layer, in.	AM Reading, %	PM Reading, %
Calibration Area	0 to 6	1.7	1.7
	6 to 12	2.3	2.3
	12 to 24	3.7	3.7
	24 to 36	3.6	3.6
	36 to 48	4.1	4.1
Mogul Area	0 to 6	1.7	1.7
	6 to 12	2.0	2.0
	12 to 24	3.6	3.6
	24 to 36	3.9	3.9
	36 to 48	4.0	4.0
Desert Extreme Area	0 to 6	1.6	1.6
	6 to 12	2.0	2.0
	12 to 24	3.4	3.4
	24 to 36	3.9	3.9
	36 to 48	4.1	4.1

Date: October 04, 2004
Times: (0615), (1300)

Probe Location:	Layer, in.	AM Reading, %	PM Reading, %
Calibration Area	0 to 6	1.8	1.8
	6 to 12	2.3	2.3
	12 to 24	3.7	3.7
	24 to 36	3.7	3.7
	36 to 48	4.1	4.1
Mogul Area	0 to 6	1.7	1.7
	6 to 12	2.0	2.0
	12 to 24	3.6	3.6
	24 to 36	3.9	3.9
	36 to 48	4.0	4.0
Desert Extreme Area	0 to 6	1.6	1.6
	6 to 12	2.0	2.0
	12 to 24	3.4	3.4
	24 to 36	3.9	3.9
	36 to 48	4.1	4.1

Date: October 05, 2004
Times: (0645), (1315)

Probe Location:	Layer, in.	AM Reading, %	PM Reading, %
Calibration Area	0 to 6	1.8	1.8
	6 to 12	2.3	2.3
	12 to 24	3.7	3.7
	24 to 36	3.6	3.7
	36 to 48	4.1	4.1
Mogul Area	0 to 6	1.7	1.7
	6 to 12	2.0	2.0
	12 to 24	3.6	3.6
	24 to 36	3.9	3.9
	36 to 48	4.0	4.0
Desert Extreme Area	0 to 6	1.6	1.6
	6 to 12	2.0	2.0
	12 to 24	3.4	3.4
	24 to 36	3.9	3.9
	36 to 48	4.1	4.1

Date: October 06, 2004
Times: (0615), (1245)

Probe Location:	Layer, in.	AM Reading, %	PM Reading, %
Calibration Area	0 to 6	1.8	1.8
	6 to 12	2.3	2.3
	12 to 24	3.7	3.7
	24 to 36	3.6	3.7
	36 to 48	4.1	4.1
Mogul Area	0 to 6	1.7	1.7
	6 to 12	2.0	2.0
	12 to 24	3.6	3.6
	24 to 36	3.9	3.9
	36 to 48	4.0	4.0
Desert Extreme Area	0 to 6	1.6	1.6
	6 to 12	2.0	2.0
	12 to 24	3.4	3.4
	24 to 36	3.9	3.9
	36 to 48	4.1	4.1

Date: October 07, 2004
Times: (0630), (1230)

Probe Location:	Layer, in.	AM Reading, %	PM Reading, %
Calibration Area	0 to 6	1.8	1.8
	6 to 12	2.2	2.2
	12 to 24	3.7	3.7
	24 to 36	3.6	3.6
	36 to 48	4.1	4.1
Mogul Area	0 to 6	1.7	1.7
	6 to 12	2.0	2.0
	12 to 24	3.6	3.6
	24 to 36	3.9	3.9
	36 to 48	4.0	4.0
Desert Extreme Area	0 to 6	1.6	1.6
	6 to 12	2.0	2.0
	12 to 24	3.4	3.4
	24 to 36	3.9	3.9
	36 to 48	4.1	4.1

APPENDIX D. DAILY ACTIVITY LOG

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
09/29/2004	2	CALIBRATION LANES	0645	0805	80	INITIAL SETUP MOBILIZATION	SETUP MOBILIZATION	NA	NA	NA	SUNNY	DRY
09/29/2004	2	CALIBRATION LANES	0805	0810	5	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	LINEAR	SUNNY	DRY
09/29/2004	2	CALIBRATION LANES	0810	0930	80	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH TOTAL HITS 110	NA	NA	LINEAR	SUNNY	DRY
09/29/2004	2	BLIND TEST GRID	0930	1035	65	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST TOTAL HITS 175	NA	NA	LINEAR	SUNNY	HOT
09/29/2004	2	BLIND TEST GRID	1035	1105	30	BREAK/LUNCH	BREAK	NA	NA	LINEAR	SUNNY	HOT
09/29/2004	2	BLIND TEST GRID	1105	1205	60	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
09/29/2004	2	MOGUL	1205	1345	100	SETUP/DAILY START/STOP CALIBRATION	SETUP/MOBILIZATION SET UP TEST AREA GRID J1/J2/ J3	NA	NA	NA	SUNNY	HOT
09/29/2004	2	MOGUL	1345	1410	25	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
09/29/2004	2	MOGUL	1410	1420	10	SETUP/DAILY START/STOP CALIBRATION	SETUP/MOBILIZATION SET UP TEST AREA GRID J1/J2/ J3	NA	NA	NA	SUNNY	HOT
09/29/2004	2	MOGUL	1420	1450	30	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRID J1/J2/J3	NA	NA	LINEAR	SUNNY	HOT
09/29/2004	2	MOGUL	1450	1500	10	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
09/30/2004	2	MOGUL	0630	0720	50	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION SET UP TEST AREA GRID J1/J2/ J3	NA	NA	NA	SUNNY	WARM

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
09/30/2004	2	MOGUL	0720	0800	40	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	WARM
09/30/2004	2	MOGUL	0800	0855	55	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRID J1/J2/J3	GPS	NA	LINEAR	SUNNY	WARM
09/30/2004	2	MOGUL	0855	0940	45	BREAK/LUNCH	BREAK	GPS	NA	LINEAR	SUNNY	WARM
09/30/2004	2	MOGUL	0940	1045	65	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRID J1/J2/J3	GPS	NA	LINEAR	SUNNY	HOT
09/30/2004	2	MOGUL	1045	1100	15	DOWNTIME DUE TO EQUIP MAIN/CHECK	CHECK DATA	NA	NA	NA	SUNNY	HOT
09/30/2004	2	MOGUL	1100	1145	45	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
09/30/2004	2	MOGUL	1145	1315	90	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRID J1/J2/J3	GPS	NA	LINEAR	SUNNY	HOT
09/30/2004	2	MOGUL	1315	1353	38	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
09/30/2004	2	MOGUL	1353	1500	67	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRID J1/J2/J3	GPS	NA	LINEAR	SUNNY	HOT
09/30/2004	2	MOGUL	1500	1510	10	SETUP/DAILY START/STOP/ CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/01/2004	2	MOGUL	0620	0710	50	SETUP/DAILY START/STOP CALIBRATION	SETUP/MOBILIZATION SET UP TEST AREA GRID J1/J2/ J3	NA	NA	NA	SUNNY	COOL
10/01/2004	2	MOGUL	0725	0745	20	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	COOL
10/01/2004	2	MOGUL	0745	0830	45	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRID J1/J2/J3 TOTAL HITS 152	GPS	NA	LINEAR	SUNNY	COOL

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
10/01/2004	2	MOGUL	0830	0845	15	SETUP/DAILY START/STOP CALIBRATION	SETUP/MOBILIZATION SET UP TEST AREA GRIDS H1-H3/I1-I3	NA	NA	NA	SUNNY	WARM
10/01/2004	2	MOGUL	0845	0925	40	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/01/2004	2	MOGUL	0925	0940	15	SETUP/DAILY START/STOP CALIBRATION	SETUP/MOBILIZATION SET UP TEST AREA GRIDS H1-H3/I1-I3	NA	NA	NA	SUNNY	WARM
10/01/2004	2	MOGUL	0940	1045	65	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS H1-H3 AND I1-I3	GPS	NA	LINEAR	SUNNY	WARM
10/01/2004	2	MOGUL	1045	1105	20	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/01/2004	2	MOGUL	1105	1215	70	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS H1-H3 AND I1-I3 TOTAL HITS 56	GPS	NA	LINEAR	SUNNY	HOT
10/01/2004	2	MOGUL	1215	1330	75	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
10/01/2004	2	OPEN FIELD	1330	1435	65	SETUP/DAILY START/STOP CALIBRATION	SETUP/MOBILIZATION SET UP TEST AREA GRIDS A2-A5 AND 70 % B2-B5	NA	NA	NA	SUNNY	HOT
10/01/2004	2	OPEN FIELD	1435	1445	10	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS EQUIPMENT BREAKDOWN	GPS	NA	LINEAR	SUNNY	HOT
10/04/2004	2	MOGUL	0615	0715	60	SETUP/DAILY START/STOP CALIBRATION	SETUP/MOBILIZATION SET UP TEST AREA FOR MOGUL	NA	NA	NA	SUNNY	COOL
10/04/2004	2	MOGUL	0715	0945	150	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST MOGUL	GPS	NA	LINEAR	SUNNY	COOL
10/04/2004	2	MOGUL	0945	1050	65	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/04/2004	2	OPEN FIELD	1050	1200	70	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST OPEN FIELD	GPS	NA	LINEAR	SUNNY	WARM
10/04/2004	2	OPEN FIELD	1200	1255	55	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
10/04/2004	2	OPEN FIELD	1255	1354	59	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS A2-A5 AND 70% B2-B5	GPS	NA	LINEAR	SUNNY	HOT
10/04/2004	2	OPEN FIELD	1354	1402	8	DOWNTIME DUE TO EQUIP MAIN/CHECK	CHANGE BATTERY	NA	NA	NA	SUNNY	HOT
10/04/2004	2	OPEN FIELD	1402	1500	58	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS A2-A5 AND 70% B2-B5	GPS	NA	LINEAR	SUNNY	HOT
10/04/2004	2	OPEN FIELD	1500	1525	25	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/05/2004	2	OPEN FIELD	0610	0710	60	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION	NA	NA	NA	SUNNY	COOL
10/05/2004	2	OPEN FIELD	0710	0902	112	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS A2-A5 AND B2-B5	GPS	NA	LINEAR	SUNNY	COOL
10/05/2004	2	OPEN FIELD	0902	0935	33	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
10/05/2004	2	OPEN FIELD	0935	1120	105	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS A2-A5 AND B2-B5	GPS	NA	LINEAR	SUNNY	HOT
10/05/2004	2	OPEN FIELD	1120	1215	55	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
10/05/2004	2	OPEN FIELD	1215	1345	90	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS A2-A5 AND B2-B5 425 HITS TOTAL	GPS	NA	LINEAR	SUNNY	HOT
10/05/2004	2	OPEN FIELD	1345	1420	35	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
10/05/2004	2	OPEN FIELD	1420	1500	40	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION SETUP TEST AREA GRIDS F2-F5 AND G2-G4	NA	NA	NA	SUNNY	HOT

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
10/05/2004	2	OPEN FIELD	1500	1515	15	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/06/2004	2	OPEN FIELD	0615	0650	35	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION	NA	NA	NA	SUNNY	COOL
10/06/2004	2	OPEN FIELD	0650	0700	10	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	COOL
10/06/2004	2	OPEN FIELD	0700	0900	120	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS F2-F5 AND G2-G4	GPS	NA	LINEAR	SUNNY	COOL
10/06/2004	2	OPEN FIELD	0900	0935	35	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/06/2004	2	OPEN FIELD	0935	1145	130	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS F2-F5 AND G2-G4	GPS	NA	LINEAR	SUNNY	HOT
10/06/2004	2	OPEN FIELD	1145	1240	5	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
10/06/2004	2	OPEN FIELD	1240	1405	85	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS F2-F5 AND G2-G4 328 HITS TOTAL	GPS	NA	LINEAR	SUNNY	HOT
10/06/2004	2	OPEN FIELD	1405	1455	50	SETUP/DAILY START/STOP CALIBRATION	SETUP/MOBILIZATIO N SET UP TEST AERA GRIDS E2-E5	NA	NA	NA	SUNNY	HOT
10/06/2004	2	OPEN FIELD	1455	1510	15	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/07/2004	2	OPEN FIELD	0615	0645	30	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION	NA	NA	NA	SUNNY	COOL
10/07/2004	2	OPEN FIELD	0645	0650	5	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	LINEAR	SUNNY	COOL

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
10/07/2004	2	OPEN FIELD	0650	0910	140	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS E2-E5 168 HITS TOTAL	GPS	NA	LINEAR	SUNNY	COOL
10/07/2004	2	OPEN FIELD	0910	1010	60	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/07/2004	2	OPEN FIELD	1010	1125	75	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST SURVEY POINTS OPEN FIELD	GPS	NA	LINEAR	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1125	1215	50	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1215	1315	60	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST SURVEY POINTS OPEN FIELD	GPS	NA	LINEAR	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1315	1340	25	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1340	1420	40	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST SURVEY POINTS OPEN FIELD	GPS	NA	LINEAR	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1420	1500	40	DEMOBILIZATION	DEMOBILIZATION END OF TEST TURN-IN DATA	NA	NA	NA	SUNNY	HOT
TEAM B												
09/29/2004	2	CALIBRATION LANES	0930	1010	40	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION	NA	NA	NA	SUNNY	HOT
09/29/2004	2	CALIBRATION LANES	1010	1015	5	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	HOT
09/29/2004	2	CALIBRATION LANES	1015	1105	50	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH TOTAL HITS 100	NA	NA	NA	SUNNY	HOT

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
09/29/2004	2	CALIBRATION LANES	1105	1225	80	BREAK/LUNCH	LUNCH	NA	NA	LINEAR	SUNNY	HOT
09/29/2004	2	BLIND TEST GRID	1225	1330	65	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST TOTAL HITS 169	NA	NA	LINEAR	SUNNY	HOT
09/29/2004	2	BLIND TEST GRID	1330	1420	50	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
09/29/2004	2	YUMA EXTREME	1420	1455	25	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION SETUP TEST AREA GRID H7	NA	NA	NA	SUNNY	HOT
09/29/2004	2	YUMA EXTREME	1455	1505	10	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
09/30/2004	2	YUMA EXTREME	0630	0750	80	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION SET UP TEST AREA GRID H7	NA	NA	NA	SUNNY	WARM
09/30/2004	2	YUMA EXTREME	0750	0835	45	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	WARM
09/30/2004	2	YUMA EXTREME	0835	1015	100	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH GRID H7/G7	GPS	NA	LINEAR	SUNNY	WARM
09/30/2004	2	YUMA EXTREME	1015	1145	90	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
09/30/2004	2	YUMA EXTREME	1145	1325	100	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH GRID H7/G7	GPS	NA	LINEAR	SUNNY	HOT
09/30/2004	2	YUMA EXTREME	1325	1353	28	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
09/30/2004	2	YUMA EXTREME	1353	1500	67	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH GRID H7/G7	GPS	NA	LINEAR	SUNNY	HOT

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
09/30/2004	2	YUMA EXTREME	1500	1510	10	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/01/2004	2	YUMA EXTREME	0620	0710	50	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION SET UP TEST AREA GRID H7/G7	NA	NA	NA	SUNNY	COOL
10/01/2004	2	YUMA EXTREME	0710	0730	20	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	COOL
10/01/2004	2	YUMA EXTREME	0730	0950	140	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH GRID H7/G7	GPS	NA	LINEAR	SUNNY	WARM
10/01/2004	2	YUMA EXTREME	0950	1005	15	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION SET UP TEST AREA GRID H8/G8	NA	NA	NA	SUNNY	WARM
10/01/2004	2	YUMA EXTREME	1005	1110	65	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	WARM
10/01/2004	2	YUMA EXTREME	1110	1315	125	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH GRID H8/G8	GPS	NA	LINEAR	SUNNY	HOT
10/01/2004	2	YUMA EXTREME	1315	1345	30	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
10/01/2004	2	YUMA EXTREME	1345	1438	53	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH GRID H8/G8	GPS	NA	NA	SUNNY	HOT
10/01/2004	2	YUMA EXTREME	1438	1450	12	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/04/2004	2	OPEN FIELD	0615	0650	35	SETUP/DAILY START/STOP CALIBRATION	SETUP/ MOBILIZATION SET UP TEST AREA GRIDS A2-A5 AND 70% B2-B5	NA	NA	NA	SUNNY	COOL

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
10/04/2004	2	OPEN FIELD	0650	0715	25	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	COOL
10/04/2004	2	OPEN FIELD	0715	0850	95	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS A2-A5 AND 70% B2-B5	GPS	NA	LINEAR	SUNNY	COOL
10/04/2004	2	OPEN FIELD	0850	0927	37	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/04/2004	2	OPEN FIELD	0927	1030	63	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS A2-A5 AND 70% B2-B5	GPS	NA	LINEAR	SUNNY	WARM
10/04/2004	2	OPEN FIELD	1030	1100	30	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/04/2004	2	YUMA EXTREME	1100	1215	75	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST YUMA EXTREME	GPS	NA	LINEAR	SUNNY	WARM
10/04/2004	2	YUMA EXTREME	1215	1326	71	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
10/04/2004	2	YUMA EXTREME	1326	1518	112	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS G7/G8/H7/H8 308 HITS TOTAL	GPS	NA	LINEAR	SUNNY	HOT
10/04/2004	2	YUMA EXTREME	1518	1525	7	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/05/2004	2	OPEN FIELD	0610	0840	150	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION SET UP TEST AREA GRIDS C2-C5 AND 70% D2-D5	NA	NA	NA	SUNNY	COOL
10/05/2004	2	OPEN FIELD	0840	0850	10	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	COOL

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
10/05/2004	2	OPEN FIELD	0850	0925	35	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS C2-C5 AND 70% D2-D5	GPS	NA	LINEAR	SUNNY	COOL
10/05/2004	2	OPEN FIELD	0925	1000	35	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/05/2004	2	OPEN FIELD	1000	1135	95	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS C2-C5 AND 70% D2-D5	GPS	NA	LINEAR	SUNNY	WARM
10/05/2004	2	OPEN FIELD	1135	1225	50	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	HOT
10/05/2004	2	OPEN FIELD	1225	1405	100	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS C2-C5 AND 70% D2-D5	GPS	NA	LINEAR	SUNNY	HOT
10/05/2004	2	OPEN FIELD	1405	1420	15	BREAK/LUNCH	BREAK	NA	NA	LINEAR	SUNNY	HOT
10/05/2004	2	OPEN FIELD	1420	1455	35	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS C2-C5 AND 70% D2-D5	GPS	NA	LINEAR	SUNNY	HOT
10/05/2004	2	OPEN FIELD	1455	1515	20	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/06/2004	2	OPEN FIELD	0615	0650	35	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION	NA	NA	NA	SUNNY	COOL
10/06/2004	2	OPEN FIELD	0650	0655	5	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	COOL
10/06/2004	2	OPEN FIELD	0655	0850	115	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS C2-C5 AND D2-D5	GPS	NA	LINEAR	SUNNY	COOL
10/06/2004	2	OPEN FIELD	0850	0925	35	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	Operational Status Comments	Track Method	Track Method= Other Explain	Pattern	Field Conditions	
10/06/2004	2	OPEN FIELD	0925	1130	125	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS C2-C5 AND D2-D5	GPS	NA	LINEAR	SUNNY	HOT
10/06/2004	2	OPEN FIELD	1130	1235	65	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
10/06/2004	2	OPEN FIELD	1235	1455	130	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS C2-C5 AND D2-D5	GPS	NA	LINEAR	SUNNY	HOT
10/06/2004	2	OPEN FIELD	1455	1510	15	SETUP/DAILY START/STOP CALIBRATION	END OF DAILY OPERATIONS/ EQUIPMENT BREAKDOWN	NA	NA	NA	SUNNY	HOT
10/07/2004	2	OPEN FIELD	0615	0640	25	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION	NA	NA	NA	SUNNY	COOL
10/07/2004	2	OPEN FIELD	0640	0645	5	SETUP/DAILY START/STOP CALIBRATION	CALIBRATED SYSTEM	NA	NA	NA	SUNNY	COOL
10/07/2004	2	OPEN FIELD	0645	0910	145	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL EAST TO WEST GRIDS C2-C5 AND D2-D5 463 HITS TOTAL	GPS	NA	LINEAR	SUNNY	COOL
10/07/2004	2	OPEN FIELD	0910	1020	70	BREAK/LUNCH	BREAK	NA	NA	NA	SUNNY	WARM
10/07/2004	2	YUMA EXTREME	1020	1125	65	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH SURVEY POINTS YUMA EXTERME	GPS	NA	LINEAR	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1125	1130	5	SETUP/DAILY START/STOP CALIBRATION	SETUP MOBILIZATION	NA	NA	NA	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1130	1225	55	COLLECT DATA	COLLECTED DATA BI-DIRECTIONAL NORTH TO SOUTH SURVEY POINTS OPEN FIELD	GPS	NA	LINEAR	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1225	1340	75	BREAK/LUNCH	LUNCH	NA	NA	NA	SUNNY	HOT
10/07/2004	2	OPEN FIELD	1340	1500	80	DEMOBILIZATION	DEMOBILIZATION END OF TEST TURN-IN DATA	NA	NA	NA	SUNNY	HOT

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APPENDIX E. REFERENCES

1. Standardized UXO Technology Demonstration Site Handbook, DTC Project No. 8-CO-160-000-473, Report No. ATC-8349, March 2002.

2. Aberdeen Proving Ground Soil Survey Report, October 1998.

3. Data Summary, UXO Standardized Test Site: APG Soils Description, May 2002.

4. Yuma Proving Ground Soil Survey Report, May 2003.

5. Practical Nonparametric Statistics, W.J. Conover, John Wiley & Sons, 1980, pages 144 through 151.

APPENDIX F. ABBREVIATIONS

AEC	=	U.S. Army Environmental Center
APG	=	Aberdeen Proving Ground
ASCII	=	American Standard Code for Information Interchange.
ATC	=	U.S. Army Aberdeen Test Center
EM	=	electromagnetic
EMI	=	electromagnetic interference
EMIS	=	Electromagnetic Induction Spectroscopy
ERDC	=	U.S. Army Corps of Engineers Engineering Research and Development Center
ESTCP	=	Environmental Security Technology Certification Program
EQT	=	Army Environmental Quality Technology Program
HEAT	=	high-explosive, antitank
GPS	=	Global Positioning System
JPG	=	Jefferson Proving Ground
POC	=	point of contact
QA	=	quality assurance
QC	=	quality control
ROC	=	receiver-operating characteristic
RTK	=	real time kinematic
RTS	=	Robotic Total Station
SERDP	=	Strategic Environmental Research and Development Program
UXO	=	unexploded ordnance
YPG	=	U.S. Army Yuma Proving Ground

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